Dolby Atmos® Master ADM Profile

VERSION 1.1

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1 Introduction to this documentation

This documentation provides detailed information about the Dolby Atmos master Audio Definition Model (ADM) profile. It is intended primarily for application developers who wish to implement support for Audio Definition Model Broadcast Wave Format (ADM BWF) .wav files in a manner that enables interoperability with Dolby tools and other industry tools.

- About the Dolby Atmos master ADM profile
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1.1 About the Dolby Atmos master ADM profile

This topic describes the Dolby Atmos master ADM profile, which is based on the ITU-R BS.2076 Audio Definition Model (ADM) specification to carry Dolby Atmos content.

Object-based audio provides greater flexibility to create, transmit, and present content. Through the use of objects, an immersive and/or personalized experience can be provided. Each object is an audio signal plus its associated object audio metadata that contains individually assigned object properties, content description, or interactivity limitations for personalization. The object properties more explicitly specify how the content creator intends the audio content to be rendered to loudspeakers. The storage, interchange, and transmission formats for object-based audio and its metadata can vary to satisfy different requirements for each application.

The ITU-R BS.2076 Audio Definition Model (ADM) specifies a metadata model to ensure compatibility for content production and program exchange systems that support object-based audio and its metadata. Content utilizing ADM can serve as input to new types of content production, emission, and content distribution services for object-based audio. To preserve artistic intent and interoperability with established workflows, systems should be able to map or convert metadata to the ADM format from its own supported metadata format.

A Dolby Atmos® master is used in the production and distribution of a single program of audio and metadata for immersive cinematic, premium episodic, music and episodic spoken-word content. Note that Dolby Atmos masters support the immersive audio aspects of Next Generation Audio (NGA), but currently do not support the personalized aspects of NGA. Dolby Atmos masters can be delivered using ADM, but not all the ADM elements are required or utilized to do so. This documentation specifies the required subset of ADM to define a Dolby Atmos master ADM profile. The profile is intended to support easier use and implementation of ADM and ensure interoperability among ADM-capable systems ingesting or outputting Dolby Atmos content.

1.2 About this documentation

This documentation specifies requirements, recommendations, and constraints for the Dolby Atmos ADM profile. The profile is defined as specific uses of ADM XML elements, attributes, and sub-elements.

This documentation.

- Specifies the presence of certain elements, attributes, and sub-elements
- Limits the range of certain parameters
- Defines the ADM topology applicable to the profile

1.2.1 Compliance notation

This documentation uses common notations to denote compliance.

- “Must,” “shall,” and “will” denote mandatory provisions.
- “Should” denotes a provision that is recommended but not mandatory.
- “May” denotes an optional feature whose presence or absence does not preclude compliance.

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1.2.2 Abbreviations

Refer to the glossary for abbreviations used in this documentation.

1.3 New in this version

- Compliance wording more clearly specified for ADM XML elements, including replacement of descriptive wording with compliance notation.
- Minimum and maximum character lengths specified for ADM XML elements with variable length.
- Additional general requirements and constraints specified for the ADM XML.
- Clarification that previously optional sub elements and/or attributes shall not be present.
- Addition of section 3 describing the use of IDs and values by the ADM XML elements
- Addition of a section 7 specifying requirements and constraints on the Broadcast Wave Format file.

1.4 References

Other published documentation is essential to the understanding and application of this documentation. References include:

- ITU-R BS.2076-0, Audio Definition Model
- ITU-R BS.2076-2, Audio Definition Model
- ITU-R BS.2088-1, Long-form file format for the international exchange of audio programme materials with metadata
- ITU-R BS.2094-1, Common definitions for the audio definition model
- EBU Tech 3285: Specification of the Broadcast Wave Format (BWF)
- EBU Tech 3285 Supplement 6: Dolby Metadata, <dbmd> chunk
- EBU Tech 3306: RF64: An Extended File Format for Audio v1.1

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2 ADM XML requirements, recommendations, and constraints

This section outlines the requirements, recommendations, and constraints of the Dolby Atmos master ADM profile concerning the structure, topology, and usage of ADM XML metadata according to ITU-R BS.2076-0.

- General requirements
- `audioTrackFormat` requirements/constraints
- `audioStreamFormat` requirements/constraints
- `audioChannelFormat` requirements/constraints
- `audioBlockFormat` requirements/constraints
- `audioPackFormat` requirements/constraints
- `audioObject` requirements/constraints
- `audioContent` requirements/constraints
- `audioProgramme` requirements/constraints
- `audioTrackUID` requirements/constraints

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2.1 General requirements

In addition to requirements and constraints on the individual XML elements in ADM, the Dolby Atmos master ADM profile also specifies the following general requirements.

- The ADM XML metadata shall be conformant to ITU-R BS.2076-0 unless otherwise specified in the following requirements
- XML code shall be conformant to the Extensible Markup Language (XML) 1.0 Specification
- XML code shall use UTF-8 character encoding
- Integer and floating-point numbers shall be given in a decimal representation without leading zeros
- The underlying functionality of all ADM XML elements, attributes and sub-elements listed in this profile specification shall be supported by an implementation that is conformant to this profile specification
- The presence of any ADM XML elements, attributes, and sub-elements which are not listed in this profile specification will result in non-compliance, and shall be rejected

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2.1.1 Composition and Element count requirements/constraints

The Dolby Atmos master ADM profile specifies constraints on the number of audio channels and associated metadata. These constraints are defined using several variables, as shown in Table 2-1.

Table 2-1 Variable definitions

Name	Value	Description
MIN_AO_DSPKS	0	Minimum number of audio beds
MAX_AO_DSPKS	64	Maximum number of audio beds
MIN_AO_OBJCT	0	Minimum number of dynamic audio objects
MAX_AO_OBJCT	118	Maximum number of dynamic audio objects
MIN_CHANNEL_COUNT	1	Minimum number of audio channels
MAX_CHANNEL_COUNT	128	Maximum number of audio channels
MIN_ELEMENT_COUNT	1	Minimum number of audio objects + beds
MAX_ELEMENT_COUNT	123	Maximum number of audio objects + beds

Variables `MIN_AO_DSPKRS`, `MAX_AO_DSPKRS`, `MIN_AO_OBJCT`, `MAX_AO_OBJCT` refer to the number of allowable occurrences of `audioObject` elements with specific values of attribute `typeDefinition`, as shown in Table 2-2.

Table 2-2 `audioObject` element occurrences dependent upon the setting of attribute `typeDefinition`

typeDefinition	Min Count	Max Count
DirectSpeakers	MIN_AO_DSPKS	MAX_AO_DSPKS
Objects	MIN_AO_OBJCT	MAX_AO_OBJCT

The allowable number of occurrences of top-level ADM elements is shown in Table 2-3.

Table 2-3 Element count restrictions

XML element	Min Count	Max Count
audioTrackFormat	MIN_CHANNEL_COUNT	MAX_CHANNEL_COUNT
audioStreamFormat	MIN_CHANNEL_COUNT	MAX_CHANNEL_COUNT
audioChannelFormat	MIN_CHANNEL_COUNT	MAX_CHANNEL_COUNT
audioPackFormat	MIN_ELEMENT_COUNT	MAX_ELEMENT_COUNT
audioObject	MIN_ELEMENT_COUNT	MAX_ELEMENT_COUNT
audioContent	MIN_ELEMENT_COUNT	MAX_ELEMENT_COUNT
audioProgramme	1	1
audioTrackUID	MIN_CHANNEL_COUNT	MAX_CHANNEL_COUNT

2.2 `audioTrackFormat` requirements/constraints

This section describes requirements for attributes and sub-elements of the `audioTrackFormat` element.

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Table 2-4 `audioTrackFormat` attribute requirements/constraints

Attribute	Requirement/constraint	Required
`audioTrackFormatID`	See section 3.2	Yes
`audioTrackFormatName`	Min length 1 char, max length should not exceed 64 chars (encoded as UTF-8) Shall equal attribute `audioStreamFormatName` in `audioStreamFormat`, referenced by sub-element `audioStreamFormatIDRef`	Yes
`formatLabel`	Shall be set to `0001`	Yes
`formatDefinition`	Shall be set to `PCM`	Yes

Table 2-5 `audioTrackFormat` sub-element requirements/constraints

Sub-element	Requirement/constraint	Min Qty	Max Qty
`audioStreamFormatIDRef`	The `IDRef` shall match the ID of a present `audioStreamFormat` element Hexadecimal value `yyyyxxxx` in `AS_yyyyxxxx` shall match value `yyyyxxxx` in attribute `audioTrackFormatID`	1	1

2.3 `audioStreamFormat` requirements/constraints

This section describes requirements for attributes and sub-elements of the `audioStreamFormat` element.

Table 2-6 `audioStreamFormat` attribute requirements/constraints

Attribute	Requirement/constraint	Required
`audioStreamFormatID`	See section 3.2	Yes
`audioStreamFormatName`	Min length 1 char, max length should not exceed 64 chars (encoded as UTF-8). Shall equal the concatenation of '`PCM_`' and attribute value `audioChannelFormatName` in `audioChannelFormat`, referenced by sub-element `audioChannelFormatIDRef`	Yes
`formatLabel`	Shall be set to `0001`	Yes
`formatDefinition`	Shall be set to `PCM`	Yes

Table 2-7 audioStreamFormat sub-element requirements/constraints

Sub-element	Requirement/constraint	Min Qty	Max Qty
`audioChannelFormatIDRef`	The `IDRef` shall match the `ID` of a present `audioChannelFormat` element Hexadecimal value `yyyyxxxx` in `AC_yyyyxxxx` shall match value	1	1

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	yyyyxxxx in attribute audioStreamFormatID		
audioPackFormatIDRef	The IDRef shall match the ID of a present audioPackFormat element	1	1
audioTrackFormatIDRef	The IDRef shall match the ID of a present audioTrackFormat element Hexadecimal value yyyyxxxx in AT_yyyyxxxx_zz shall match value yyyyxxxx in attribute audioStreamFormatID	1	1

Although ITU-R BS.2076-0 implies that audioChannelFormat and audioPackFormat identification references within the audioStreamFormat element be mutually exclusive, Dolby Atmos master ADM BWF files contain both audioChannelFormat and audioPackFormat identification references.

2.4 audioChannelFormat requirements/constraints

This section describes requirements for attributes and sub-elements of the audioChannelFormat element.

Table 2-8 audioChannelFormat attribute requirements/constraints

Attribute	Requirement/constraint	Required
audioChannelFormatID	See section 3.1	Yes
audioChannelFormatName	Min length 1 char, max length should not exceed 64 chars (encoded as UTF-8)	Yes
typeLabel	Shall be set to 0001 or 0003	Yes
typeDefinition	Shall be set to DirectSpeakers or Objects	Yes

Table 2-9 audioChannelFormat sub-element requirements/constraints

Sub-element	Requirement/constraint	Min Qty	Max Qty
audioBlockFormat	See section 3.1 Hexadecimal value yyyyxxxx in attribute audioBlockFormatID AB_yyyyxxxx_zzzzzzzz shall match value yyyyxxxx in parent attribute audioChannelFormatID	1	See below
all other sub-elements	Shall not be present	0	0

The maximum number of occurrences of sub-element audioBlockFormat is dependent upon the value of attribute typeDefinition, shown in Table 2-10.

Table 2-10 audioBlockFormat sub-element number of occurrences constraints

typeDefinition	Max Qty
DirectSpeakers	1
Objects	No limit

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In addition to the above requirements

- A Dolby Atmos master ADM BWF file shall use only custom `DirectSpeakers` definitions
- `audioChannelFormats` of typeDefinition `DirectSpeakers` shall use only the attribute settings/values listed in Table 2-11.

Table 2-11 `audioChannelFormat` attribute values for typeDefinition `DirectSpeakers`

Channel assignment	audioChannelFormatID	audioChannelFormatName
Left (L)	See section 3.1	`RoomCentricLeft`
Right (R)		`RoomCentricRight`
Center (C)		`RoomCentricCenter`
Low-Frequency Effects (LFE)		`RoomCentricLFE`
Left Side Surround (Lss)		`RoomCentricLeftSideSurround`
Right Side Surround (Rss)		`RoomCentricRightSideSurround`
Left Rear Surround (Lrs)		`RoomCentricLeftRearSurround`
Right Rear Surround (Rrs)		`RoomCentricRightRearSurround`
Left Top Surround (Lts)		`RoomCentricLeftTopSurround`
Right Top Surround (Rts)		`RoomCentricRightTopSurround`
Left Surround (Ls)		`RoomCentricLeftSurround`
Right Surround (Rs)		`RoomCentricRightSurround`

- `audioChannelFormat` of typeDefinition `DirectSpeakers` are only present in certain channel configurations. See section 2.6.

2.5 `audioBlockFormat` requirements/constraints

This section describes requirements for attributes and sub-elements of the `audioBlockFormat` element.

Table 2-12 `audioBlockFormat` attribute requirements/constraints

Attribute	Requirement/constraint	Required
`audioBlockFormatID`	See section 3.1	Yes
`rtime`	-	See below
`duration`	-	See below

Attributes `rtime` and `duration` shall only be present if the value of parent `audioChannelFormat` attribute `typeDefinition` is set to `Objects`.

Dolby Atmos master ADM BWF files shall only utilize custom `audioChannelFormats`. The value of parent `audioChannelFormat` attribute `typeDefinition` defines which specific `audioBlockFormat` sub-element and attribute values are present. Where applicable, constraints on their values are also specified in the following tables.

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Table 2-13 `audioBlockFormat` `typeDefinition` `DirectSpeakers` sub-element requirements/constraints

Sub-element	Requirement/constraint	Min Qty	Max Qty
`cartesian`	Shall be set to 1	1	1
`speakerLabel`	See Table 2-14	1	1
`position`	See Table 2-14	3	3
all other sub-elements	Shall not be present	0	0

Table 2-14 `audioBlockFormat` `typeDefinition` `DirectSpeakers` sub-element values

Channel assignment	speakerLabel	position.coordinate		
		X	Y	Z
Left (L)	`RC_L`	`-1.0`	`1.0`	`0.0`
Right (R)	`RC_R`	`1.0`	`1.0`	`0.0`
Center (C)	`RC_C`	`0.0`	`1.0`	`0.0`
Low-Frequency Effects (LFE)	`RC_LFE`	`-1.0`	`1.0`	`-1.0`
Left Side Surround (Lss)	`RC_Lss`	`-1.0`	`0.0`	`0.0`
Right Side Surround (Rss)	`RC_Rss`	`1.0`	`0.0`	`0.0`
Left Rear Surround (Lrs)	`RC_Lrs`	`-1.0`	`-1.0`	`0.0`
Right Rear Surround (Rrs)	`RC_Rrs`	`1.0`	`-1.0`	`0.0`
Left Top Surround (Lts)	`RC_Lts`	`-1.0`	`0.0`	`1.0`
Right Top Surround (Rts)	`RC_Rts`	`1.0`	`0.0`	`1.0`
Left Surround (Ls)	`RC_Ls`	`-1.0`	`-1.0`	`0.0`
Right Surround (Rs)	`RC_Rs`	`1.0`	`-1.0`	`0.0`

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Table 2-15 `audioBlockFormat typeDefinition Objects` sub-element requirements/constraints

Sub-element	Requirement/constraint	Min Qty	Max Qty
`cartesian`	Shall be set to 1	1	1
`gain`	-	0	1
`importance`	See below	0	1
`position`	Only the `coordinate` attribute shall be present, one each for axis `X`, `Y`, and `Z`. The `coordinate` attribute shall be set to a value in `[-1.0, 1.0]`	3	3
`width`	See below	0	1
`depth`	See below	0	1
`height`	See below	0	1
`diffuse`	Shall be set to `0` or `1`	0	1
`channelLock`	Optional attribute `maxDistance` shall not be present	0	1
`zoneExclusion`	See section 2.5.1	0	1
`jumpPosition`	Shall be set to `1` Attribute `interpolationLength` shall be set to `0.005208` (approximately equal to the duration of 250 samples @ 48 kHz, or 500 samples @ 96 kHz) unless hexadecimal value zzzzzzzz in parent attribute `audioBlockFormatID AB_yyyyxxxx_zzzzzzzz` is set to `0x1`, in which case it shall be set to the duration of `0.000000` (0 samples @ 48 kHz). See section 2.5.2 for additional information	1	1
all other sub-elements	Shall not be present	0	0

If `importance` is present and set to `0` then `gain` shall also be present and set to `0.0`. This combination of sub-element values indicates that the object is inactive and the PCM for that object is silent and does not contribute to the final rendered output for that block.

If any size sub-elements `[width, depth, height]` are present, then all three sub-elements must be present and set to the same value in `[0.0, 1.0]`.

2.5.1 Zone Exclusions

When zone exclusions are present, the `zone` sub-element can take on only one of the five zone sets listed in the following table. Depending upon the zone set, there will be one or more `zone` sub-elements present.

Table 2-16 Basic `zone` sub-element attribute values

Description	Attribute values						Value
	minX	maxX	minY	maxY	minZ	maxZ	
Back zone disabled	-1.0	1.0	-1.0	-0.41934	-0.499	0.499	ZM1
Side zone disabled	-1.0	-0.75806	-0.41934	0.83871	-0.499	0.499	ZM2L
	0.75806	1.0	-0.41934	0.83871	-0.499	0.499	ZM2R
Center-back zone enabled	-1.0	-0.16129	0.5	1.0	-0.499	0.499	ZM3L
	-1.0	-0.51611	-0.707	0.49999	-0.499	0.499	ZM3Lss
	0.16129	1.0	0.5	1.0	-0.499	0.499	ZM3R
	0.51611	1	-0.707	0.49999	-0.499	0.499	ZM3Rss
Screen zone enabled	-1.0	1.0	-1.0	0.83871	-0.499	0.499	ZM4
Surround zone enabled	-1.0	1.0	0.5	1.0	-0.499	0.499	ZM5

In addition to the basic zones listed in Table 2-16, elevation exclusion zones listed in Table 2-17 may also be present.

Table 2-17 Elevation `zone` sub-element attribute values

Description	Attribute values						Value
	minX	maxX	minY	maxY	minZ	maxZ	
Elevation (ceiling/floor) disabled	-1.0	1.0	-1.0	1.0	-1.0	-0.4995	ZB
	-1.0	1.0	-1.0	1.0	0.4995	1.0	ZT

A single basic `zone` and the optional elevation `zone` are combined to form a single `zoneExclusion` instance. If neither a basic `zone` nor the elevation `zone` is present, then the `zoneExclusion` sub-element is also not present.

2.5.2 Use of jumpPosition and interpolationLength

The Dolby Atmos master ADM profile makes assumptions about how metadata is interpreted and rendered. Specifically, there is an assumption that a renderer applies metadata sampling and position smoothing to the object metadata prior to panning. With this assumption, the Dolby Atmos master ADM profile treats `audioBlock` instances as a series of discrete metadata events as opposed to interpolated block-to-block metadata transitions. As a result, as described in Table 2-15, static values for the `jumpPosition` element and its `interpolationLength` attribute are used, where the event occurs at the beginning of the `audioBlock` regardless of its `interpolationLength` value. This has several implications depending on the application:

- When writing an ADM BWF file adhering to the Dolby Atmos master ADM profile, time-varying positions should be sampled. For example, when exporting timeline automation from a DAW, the metadata automation line should be sampled into metadata events as `audioBlock` instances. The

sampling period should be less than 20 milliseconds. Sampling is optional if the metadata state remains unchanged.

- As previously mentioned, when rendering, the assumption is that positional metadata is sampled and smoothed. Also, it is expected that speaker gains are interpolated between processing blocks.
- When importing a Dolby Atmos master ADM BWF file, for example in a DAW when importing ADM `audioBlocks` as visual automation lines in a timeline, positional events for a given object should be interpreted as linear interpolations (i.e. linked with straight lines) if and only if the events are less than 30 milliseconds apart. Otherwise, events should be interpreted as described by the ADM XML syntax (i.e. short ramp and hold, staircase change).

2.6 `audioPackFormat` requirements/constraints

This section describes requirements for attributes and sub-elements of the `audioPackFormat` element.

Table 2-18 `audioPackFormat` attribute requirements/constraints

Attribute	Requirement/constraint	Required
`audioPackFormatID`	See section 3.1	Yes
`audioPackFormatName`	Min length 1 char, max length should not exceed 64 chars (encoded as UTF-8)	Yes
`typeLabel`	Shall be set to `0001` or `0003`	Yes
`typeDefinition`	Shall be set to `DirectSpeakers` or `Objects`	Yes
all other attributes	Shall not be present	

Table 2-19 `audioPackFormat` sub-element requirements/constraints

Sub-element	Requirement/constraint	Min Qty	Max Qty
`audioChannelFormatIDRef`	The `IDRef` shall match the ID of a present `audioChannelFormat` element	1	See below
all other sub-elements	Shall not be present	0	0

The maximum number of occurrences of sub-element `audioChannelFormatIDRef` is dependent upon the value of attribute `typeDefinition`, shown in Table 2-20.

Table 2-20 `audioChannelFormatIDRef` sub-element number of occurrences constraints

typeDefinition	Max Qty
`DirectSpeakers`	10
`Objects`	1

The `audioPackFormat` element groups one or more `audioChannelFormats`. Within a Dolby Atmos master ADM BWF file, only certain channel configuration sets shall be used, with each set having a specific ordering of channels, as listed in the following table.

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Table 2-21 Allowed Channel Configuration Sets and Channel Ordering

Channel Configuration Set	Channel Order (by Channel Assignment Abbreviation)
2.0	L R
3.0	L R C
5.0	L R C Ls Rs
5.1	L R C LFE Ls Rs
7.0	L R C Lss Rss Lrs Rrs
7.1	L R C LFE Lss Rss Lrs Rrs
7.0.2	L R C Lss Rss Lrs Rrs Lts Rts
7.1.2	L R C LFE Lss Rss Lrs Rrs Lts Rts

2.7 `audioObject` requirements/constraints

This section describes requirements for attributes and sub-elements of the `audioObject` element.

Table 2-22 `audioObject` attribute requirements/constraints

Attribute	Requirement/constraint	Required
`audioObjectID`	See section 3.5	Yes
`audioObjectName`	Min length 1 char, max length should not exceed 64 chars (encoded as UTF-8). Also, see Table 6-1	Yes
`start`[1]	Shall be set to 00:00:00.00000	Yes
`duration`	Shall be set to the time difference between attributes start and end in the element audioProgramme	Yes
All other attributes	Shall not be present	

Table 2-23 `audioObject` sub-element requirements/constraints

Sub-element	Requirement/constraint	Min Qty	Max Qty
`audioPackFormatIDRef`	The `IDRef` shall match the ID of a present `audioPackFormat` element	1	1
`audioTrackUIDRef`	The `IDRef` shall match the ID of a present `audioTrackUID` element	1	See below
all other sub-elements	Shall not be present	0	0

The maximum number of occurrences of sub-element `audioTrackUIDRef` is dependent upon the value of `yyyy` in sub-element `audioPackFormatIDRef`, shown in Table 2-24.

[1] Some Dolby Atmos master ADM BWF files utilize `startTime` as the attribute name. See Table 4-1 for more information.

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Table 2-24 audioTrackUIDRef sub-element number of occurrences constraints

yyyy	Max Qty
0001	10
0003	1

2.8 audioContent requirements/constraints

This section describes requirements for attributes and sub elements of the audioContent element.

Table 2-25 audioContent attribute requirements/constraints

Attribute	Requirement/constraint	Required
audioContentID	See section 3.4	Yes
audioContentName	Min length 1 char, max length should not exceed 64 chars (encoded as UTF-8). Also, see Table 6-1	Yes
all other attributes	Shall not be present	

Table 2-26 audioContent sub-element requirements/constraints

Sub-element	Requirement/constraint	Min Qty	Max Qty
audioObjectIDRef	The IDRef shall match the ID of a present audioObject element	1	MAX_ELEMENT_COUNT
dialogue	See below	1	1
all other sub-elements	Shall not be present	0	0

Sub-element dialogue shall be set to 2, associated attribute mixedContentKind shall be set to 0.

Note: The dialogue sub-element and its attributes values within audioContent element is present only to comply with certain ADM XML schema constraints. This metadata should not be considered accurate.

2.9 audioProgramme requirements/constraints

This section describes requirements for attributes and sub-elements of the audioProgramme element.

Table 2-27 audioProgramme attribute requirements/constraints

Attribute	Requirement/constraint	Required
audioProgrammeID	See section 3.3	Yes
audioProgrammeName	Min length 1 char, max length should not exceed 64 chars (encoded as UTF-8)	Yes
start	The time difference between the start and end attributes shall match the duration of the associated PCM audio essence.	Yes
end		Yes
all other attributes	Shall not be present	

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Table 2-28 `audioProgramme` sub-element requirements/constraints

Sub-element	Requirement/constraint	Min Qty	Max Qty
`audioContentIDRef`	The `IDRef` shall match the ID of a present `audioContent` element	1	MAX_ELEMENT_COUNT
`audioProgrammeReferenceScreen`	See below	0	1
all other sub-elements	Shall not be present	0	0

If `audioProgrammeReferenceScreen` is present, then only sub-element `screenWidth` and associated attribute, `X` shall be present.

2.10 `audioTrackUID` requirements/constraints

This section describes requirements for attributes and sub-elements of the `audioTrackUID` element.

Table 2-29 `audioTrackUID` attribute requirements/constraints

Attribute	Requirement/constraint	Required
`UID`	See section 3.6	Yes
`sampleRate`	Shall be equal to the value of the `nSamplesPerSec` field in the `<fmt >` chunk of the encapsulating BWF file. Valid values are either `48000` or `96000`.	Yes
`bitDepth`	Shall be equal to the value of the `wBitsPerSample` field in the `<fmt >` chunk of the encapsulating BWF file. The only valid value is `24`.	Yes

Table 2-30 `audioTrackUID` sub-element requirements/constraints

Sub-element	Requirement/constraint	Min Qty	Max Qty
`audioTrackFormatIDRef`	The `IDRef` shall match the `ID` of a present `audioTrackFormat` element	1	1
`audioPackFormatIDRef`	The `IDRef` shall match the `ID` of a present `audioPackFormat` element	1	1
all other sub-elements	Shall not be present	0	0

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3 Use of IDs

Several numbering formats are used for IDs throughout the ADM XML structure, see section 6 of ITU-R BS.2076-0 for further details. In summary, the ID formats are as shown in Table 3-1.

Table 3-1 Element ID formats

Element	ID Format
audioPackFormat	AP_yyyyxxxx
audioChannelFormat	AC_yyyyxxxx
audioBlockFormat	AB_yyyyxxxx_zzzzzzzz
audioStreamFormat	AS_yyyyxxxx
audioTrackFormat	AT_yyyyxxxx_zz
audioProgramme	APR_wwww
audioContent	ACO_wwww
audioObject	AO_wwww
audioTrackUID	ATU_vvvvvvvv

3.1 audioPackFormat, audioChannelFormat, audioBlockFormat

- Hexadecimal value yyyy shall be set as indicated by Table 3-2.
- Hexadecimal value xxxx shall commence from 0x1001 and be continuous and contiguous, element xxxx counters are independent.
- Per ITU-R BS.2076-0, hexadecimal value yyyyxxxx in audioBlockFormat shall equal that of parent audioChannelFormat.
- Hexadecimal value zzzzzzzz in audioBlockFormat shall commence from 0x1 and be continuous and contiguous.

Table 3-2 audioPackFormat and audioChannelFormat yyyy requirements/constraints

yyyy	typeLabel, typeDefinition
0001	0001, DirectSpeakers
0003	0003, Objects

3.2 audioStreamFormat, audioTrackFormat

- Hexadecimal value yyyy shall be set as indicated by Table 3-3.
- Hexadecimal value xxxx shall commence from 0x1001 and be continuous and contiguous
- There shall be a single xxxx counter that is common to both audioStreamFormat and audioTrackFormat.
- Hexadecimal value zz in audioTrackFormat shall be set to 0x1.

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Table 3-3 `audioStreamFormat` and `audioTrackFormat` `yyyy` requirements/constraints

yyyy	formatLabel, formatDefinition
0001	0001, PCM
0003	0001, PCM

3.3 audioProgramme

Hexadecimal value `wwww` shall be set to `0x1001`.

3.4 audioContent

Hexadecimal value `wwww` shall commence from `0x1001` and be continuous and contiguous.

3.5 audioObject

Depending upon the value of attribute `typeDefinition` in element `audioPackFormat` referenced by `audioPackFormatIDRef`, hexadecimal value `wwww` has two value ranges that share a single `wwww` counter, as shown in Table 3-4.

Table 3-4 `audioObject` `wwww` requirements/constraints

typeDefinition	Range Start	Range End
DirectSpeakers	0x1001	0x1080
Objects	0x100b	0x1080

- Audio object `ID` values are unique, but not contiguous.
- If referenced attribute `typeDefinition=DirectSpeakers`, then the `ID` used for this object prohibits other contiguous values from being used depending on the number of occurrences of sub-element `audioTrackUIDRef`.
- If an object has an `ID` value of `O`, and contains `T` `audioTrackUIDRef` occurrences, then `ID` values in range `[O+1, O+T-1]` are prohibited from being used.

For example, if the `ID` value of an object is `0x1006`, and that object contains 6 `audioTrackUIDRef` occurrences (e.g., 5.1 channels), then `ID` values in the range `[0x1007, 0x100b]` are prohibited from being used for other audio objects; the next useable `ID` value will be `0x100c`.

3.6 audioTrackUID

Hexadecimal value `vvvvvvvv` shall commence from `0x1` and shall be continuous and contiguous.

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4 ADM versions and differences in Dolby Atmos masters

The Dolby Atmos master ADM profile complies with ITU-R BS.2076-0. This version has been superseded by ITU-R BS.2076-2, which is in force. Caution must be taken to ensure that differences between the two ADM versions do not cause a system to incorrectly reject a Dolby Atmos master ADM BWF file.

- Known issues

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4.1 Known issues

In addition to differences between ADM specification versions, there are several known issues with Dolby Atmos master ADM BWF files. These issues can be determined by the Uniform Resource Name (URN) indicated in the ADM XML. Dolby Atmos master ADM BWF files can use two URN namespaces, `ebuCore_2014`, and `ebuCore_2016`.

Table 4-1 Issues with Dolby Atmos Master ADM Based on URN

Issue	URN namespace in Dolby Atmos masters	
	`ebuCore_2014`	**`ebuCore_2016`**
Presence of `typeDefinition` attribute	This attribute is incorrectly present in the `audioTrackFormat` and `audioStreamFormat` elements	This attribute is present only in the appropriate elements
Presence of `typeLabel` attribute	This attribute is incorrectly present in the `audioTrackFormat`, `audioStreamFormat`, `audioProgramme`, `audioContent`, and `audioTrackUID` elements	This attribute is present only in the appropriate elements
`start/startTime`[2] attribute of `audioObject` element	This attribute is specified as `startTime`	This attribute is specified as `start`
Conforms to relevant schema definition	XML documentation utilizing this namespace is not guaranteed to conform to the associated schema	XML documentation utilizing this namespace conforms to the associated schema

[2] ITU-R BS.2076-0 uses `startTime` in several prose-style descriptions, but actual tables use `start`.

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5 Additional chunks (Dolby Audio metadata chunk)

In addition to carrying ADM metadata in the <aXML> chunk, Dolby Atmos master ADM BWF files contain the Dolby Audio metadata <dbmd> chunk in the encapsulating BWF file. The Dolby Audio metadata chunk contains additional metadata segments with relevant information about the content creation tools, the program, and encoder configuration for downstream processing. The Dolby Audio metadata chunk adheres to the specification defined in EBU Tech 3285 Supplement 6.

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6 Dolby Atmos master content organization and element names

Dolby Atmos master ADM BWF files utilize content organization structures to specify the name of certain ADM elements. When a name is not present, default names are given.

- Dolby Atmos master content organization
- Default name values

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6.1 Dolby Atmos master content organization

Dolby Atmos masters utilize bed instance records and object records as organizational constructs to identify content and object types present in a program.

Each bed instance record identifies a set of one or more beds (that is, content with a `typeDefinition="DirectSpeakers"`). The object record identifies how the objects (that is, content with a `typeDefinition="Objects"`) are organized. The records may contain:

- A description for each bed instance or object
- A group name to associate different bed instances and objects into groups

The Dolby Atmos master ADM profile attempts to maintain the content organization by using the records to dictate the organizational structure within ADM. The concepts of descriptions and groups correspond to the `audioObject` and `audioContent` ADM elements, respectively. These relationships are used to specify the `audioObjectName` and `audioContentName` attribute values.

Figure 6-1 shows an example Dolby Atmos master program with two bed instance records and an object record.

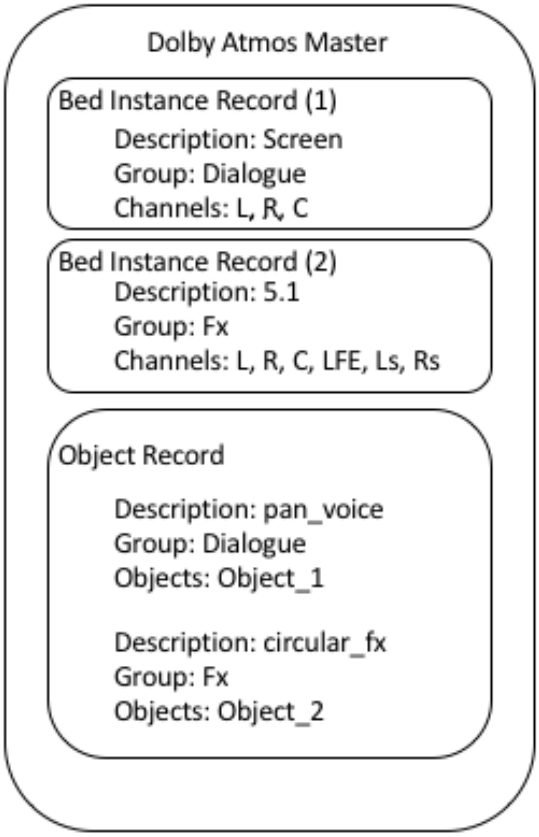

Figure 6-1 Example Dolby Atmos master content structure

Figure 6-2 shows the ADM content structure corresponding to the Dolby Atmos master records.

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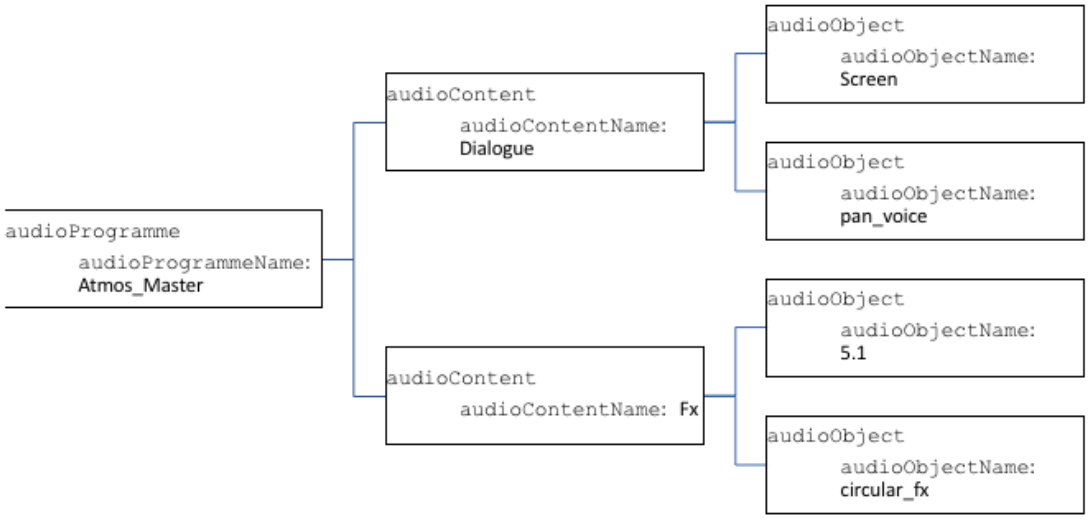

Figure 6-2 Example Dolby Atmos master ADM content structure

Note that:

- Bed instance and object record description text is used as the `audioObjectName` attribute value.
- Bed instance and object record group name text is used as the `audioContentName` attribute value.

6.2 Default name values

Default name attribute values can be used in a Dolby Atmos master ADM BWF file. The name attributes can indicate content organization (as described above) or have no meaning at all.

In certain cases, the bed instance record or object record may not include a description or be part of a content group. In situations where the description or group names are missing, special name attribute values are used, as indicated in Table 6-1.

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Table 6-1 Default name values

Attribute	Value	Use case
audioContentName	Atmos_Master_Content	Used when a bed instance or object record is not part of a group and therefore has no corresponding group name
audioObjectName	Atmos_Bed_M	Used when a bed instance does not have a description. M is a number in [1, 128]
audioObjectName	Atmos_Obj_N	Used when an object record does not have a description. N is a number in [10, 128]

Systems that ingest Dolby Atmos master ADM BWF files should try and preserve the content organization by reusing the audioContentName and audioObjectName attribute values when presenting the organizational structure of the content to the user.

Default name values are also used for the audioProgramme, audioPackFormat audioChannelFormat (for Objects type), audioStreamFormat, and audioTrackFormat elements. However, unlike audioContent and audioObject names, these values are used simply to populate the attribute when a custom name value is not used. These name values do not represent any organizational structure and are therefore not meaningful.

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7 Broadcast Wave Format requirements, recommendations, and constraints

This section outlines the requirements, recommendations, and constraints of the Dolby Atmos master ADM profile concerning the configuration of the Broadcast Wave Format file that encapsulates the PCM audio essence, ADM XML, DBMD and other chunks.

- General BWF requirements
- Chunk-specific requirements

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7.1 General BWF requirements

The following general requirements apply to the Broadcast Wave Format when used to carry a Dolby Atmos master.

- The audio format shall be PCM (`formatType` value = `0x0001` (WAVE_FORMAT_PCM)).
- The number of PCM audio channels present in the BWF file shall not exceed 128. (`channelCount` value ≤ `0x0080`).
- The sampling rate of the PCM audio shall be either 48000 Hz or 96000 Hz (`sampleRate` value = `0x0000BB80` or `0x00017700`)
- The bit depth of the PCM audio shall be 24 bits (`bitsPerSample` value = `0x0018`).
- BWF files containing 4 GByte or more of RIFF data shall use the ID "`RF64`" in the first four bytes of the file (as specified in EBU Tech 3306) and shall not use the ID "`BW64`" specified in ITU-R BS.2088-1.

7.2 Chunk-specific requirements

- Within the `<chna>` chunk (specified in ITU-R BS.2088-1):
  - The value of the `numUID` element shall be equal to the value of the `numTrack` element.
  - Each PCM audio track shall be referenced by a single UID only.
  - Unused ID structures shall not be present.
- For BWF files containing less than 4 GByte of RIFF data, the size of the `<JUNK>` chunk shall not exceed 64 bytes.
- For BWF files containing 4 GByte or more of RIFF data, the size of the `<ds64>` chunk (specified in EBU Tech 3306) shall not exceed 64 bytes.

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8 Glossary

ADM

Audio Definition Model. A metadata model specified in ITU-R BS.2076-0 that describes channel-, object-, or scene-based audio file formats.

ADM BWF

Audio Definition Model Broadcast Wave Format.

BWF

Broadcast Wave Format. An extension of the Microsoft Waveform Audio Format (WAV) file format to include metadata important to broadcast applications. This format is specified in EBU Tech 3285.

DAW

Digital audio workstation. An electronic device or computer software application used to record, edit, and produce audio files.

Max

Maximum. The maximum number or quantity of an element.

Min

Minimum. The minimum number or quantity of an element

Qty

Quantity. The number or quantity of an element.

PCM

Pulse code modulation. A method that is used to convert analog signals into digital, binary, coded pulses by sampling the analog signal, quantizing each sample independently, and converting the resulting quantized values into a digital signal.

XML

EXtensible Markup Language.

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